Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **30 SEP 1997**	2. REPORT TYPE	3. DATES COVERED **00-00-1997 to 00-00-1997**
4. TITLE AND SUBTITLE **Propagation of Cracks in Sea Ice**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Dartmouth College,Thayer School of Engineering,Hanover,NH,03755**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT **unclassified**	b ABSTRACT **unclassified**	c THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

PROPAGATION OF CRACKS IN SEA ICE

Prof. Victor F. Petrenko
Thayer School of Engineering
Dartmouth College
Hanover, NH 03755
victor.f.petrenko@dartmouth.edu
Voice: 603/646-3526 FAX: 603/646-3856
Award No. N00014-97-1-0597

LONG-TERM GOALS

This project aims to involve one graduate student into intensive study of dynamics of cracks in sea ice. The parent ONR grant does not include a student support.

OBJECTIVES

In this project we measured crack velocity as a function of ice microstructure, temperature and a load applied to ice. Experimental techniques based on electromagnetic measurements are used to determine crack velocities in various types of ice. Special attention was given to the dynamic interaction between cracks growing in ice and such micro structural ice features as brine pockets, brine channels and grain boundaries. Such interactions plus the high ductility of sea ice are suspected to be responsible for the very low velocity of cracks in sea ice. Results were analyzed according to recent advances in the general theory of crack dynamics and crack interaction. It is expected that this work will answer the question of why sea ice cracks have such low velocity and contribute to the understanding of the dynamics of ice fragmentation.

APPROACH

Experimental techniques based on measurements of electromagnetic emissions (EME's) from cracks and changes in ice electrical conductance and capacitance were used to determine crack velocities in various types of natural and artificial ice. The techniques are characterized by high-time resolution (< 1ms) and the capability to detect micro cracks (1 mm2).

SCIENTIFIC/ TECHNICAL RESULTS

None. The student was hired two weeks ago.

IMPACT FOR SCIENCE

We expect to establish the micro-mechanically based modeling of dynamic fracture of sea ice. The maximal crack speeds in ice (that set limits to the rates of fragmentation and of ice-breaking operations) will be predicted as functions of the microstructure (density and shapes of fluid inclusion, geometry of microchannel network) and of the physical properties of the fluid (density, viscosity and surface tension).

We will also predict the forces arising during the fragmentation of ice, thus making it possible to roughly estimate the maximal forces in ice-structure interactions for a given speed of ice sheets advance.

The expected results will also be relevant for other materials that contain fluid inclusions.

TRANSITIONS

None

RELATED PROJECTS

The parent ONR Grant: Contract/Grant Number: N000149510621, Contract/Grant Title: Study of Crack Dynamics in Ice by Means of Electromagnetic Methods, Principal Investigator: Victor F. Petrenko